

Vowel height and dorsals: allophonic differences cue contrasts

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Overview: A phonemic contrast between uvular and velar consonants in Quechua is often additionally cued by allophonic differences in surrounding vowel height: uvulars trigger lowering of a surrounding high vowel, e.g., [kiru] ‘tooth’ but [qeru] ‘vase’. An identification task finds that allophonic vowel height is used as a strong cue to consonant place, but that mid vowels cue uvular place more strongly than high vowels cue velar place. This is interpreted as showing that the more limited distribution of mid vowels makes these vowels more informative.

Vowel height: Cochabamba Quechua has three phonemic vowels /i u a/. The high vowels /i u/ surface as mid [e o] when a uvular [q q' q^h] precedes or follows (Bills et al. 1969), e.g., [kusa] ‘good’ but [qosa] ‘husband’. An acoustic study confirmed this lowering effect root internally, and also documented lowering from a suffixal uvular onto a root vowel, contra previous claims that lowering only applies morpheme internally (Molina Vital 2014). Root internally, vowels are lower (higher F1) when preceded by a uvular consonant than when preceded by a velar or labial, e.g., [hap'i-ni] ‘I grab’, [p'aki-ni] ‘I break’ but [saqe-ni] ‘I leave’. Across a morpheme boundary, a suffixal uvular consonant lowers a preceding stem vowel, e.g., [hap'i-ni] ‘I grab’ but [hap'e-rqa] ‘he grabbed’. This pattern holds of both front and back vowels, and comes from data collected from 10 near-monolingual speakers.

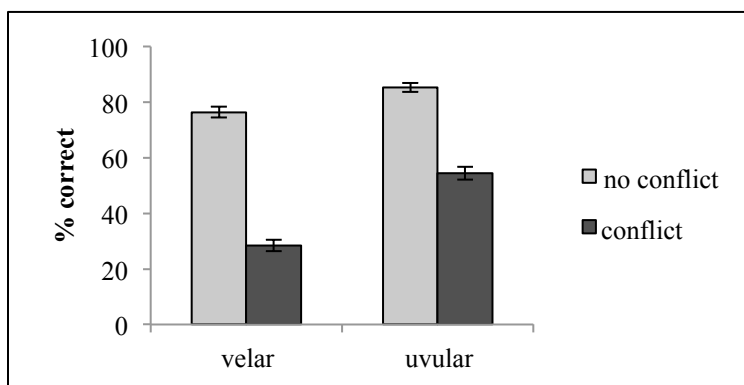
A result of vowel allophony is that the contrast between uvular and velar consonants is often cued by differences in surrounding vowels as well as in the consonants themselves. Interestingly, then, root vowels following velars, [p'ake-rqa] ‘he broke’, were found to lower just as much as vowels following labials, [hap'e-rqa] ‘he grabbed’ in the presence of a suffixal uvular consonant, indicating no blocking effect of the root velar. Vowel height, then, is not a wholly reliable cue to whether a preceding consonant is uvular or velar: high vowels are a reliable cue that a preceding consonant is velar, but mid vowels may be preceded by either a velar or uvular.

Perception study: A perception study was designed to test how Quechua speakers use consonantal and vocalic cues in distinguishing uvular and velar categories. In an identification task, 16 native speakers (Spanish bilinguals) labeled 120 stimuli as containing either a velar or uvular ejective (represented orthographically as <k'> and <q'>). Ejectives were chosen for the study because they differ only in place; plain and aspirated uvulars often spirantize (/q/ → [ɣ] and /q^h/ → [χ]) and thus contrast with their velar counterparts for manner as well place. Nonce word stimuli were made by cross-splicing the burst from a uvular and velar ejective with high and mid front vowels, creating quadruplets like [wask'ini] ~ [wasq'eni] ~ [wask'eni] ~ [wasq'ini]. Ejectives allowed for easy cross-splicing because the burst is followed by a period of silence, and the glottal closure in the ejective minimizes place cues from formant transitions in the following vowel. Closure and VOT duration were normalized across all stimuli to a value intermediate between uvulars and velars.

There are two hypotheses. First, it could be that high vowels are used as a more reliable cue than mid vowels, since speakers have practice perceiving velars before mid vowels (as in [p'akerqa]) but no practice perceiving uvulars before high vowels. Second, mid vowels may be

used as a more reliable cue than high vowels, since mid vowels occur in a more restricted range of environments, and, under traditional analyses, are derived. Under the first hypothesis, [wasq'ini] should be misidentified more often than [wask'eni]; under the second hypothesis, [wask'eni] should be misidentified more often than [wasq'ini].

Participants were more accurate at perceiving consonantal place when the consonantal and vowel cues were consistent, as in [wask'eni] and [wasq'eni], than when they conflicted, as in [wask'eni] and [wasq'ini], as can be seen in the figure below. A significant interaction between cue consistency and place ($p < 0.01$) was found in a Mixed Logit Model, indicating that conflicting cues had a stronger negative effect on accurate perception of velar place than uvular place. Stimuli like [wask'eni] were incorrectly identified as containing [q'] 72% of the time, while stimuli like [wasq'ini] were incorrectly identified as containing [k'] only 54% of the time.



Discussion: The identification study shows that Quechua listeners use allophonic vowel height as a strong cue to consonantal place: when consonantal and vocalic cues conflict, accurate identification of consonant place decreases. Mid and high vowels are not used to the same degree, however. The mid vowel [e] is interpreted as indicative of a preceding uvular [q'] more frequently than the high vowel [i] is interpreted as indicative of a preceding velar [k'].

These results support the second hypothesis, that the mid vowel [e], which occurs in a more limited set of environments and may be analyzed as derived, is used as a stronger predictor of consonant place than the high vowel [i]. This finding is interesting in light of forms like [p'akerqa] 'he broke', where a velar consonant may be followed by a mid vowel. Given that both preceding and following uvulars trigger lowering, Quechua speakers are likely quite good at identifying the position of the trigger of lowering. While mid vowels aren't necessarily a reliable cue to a *preceding* uvular, they are a reliable cue that a uvular is present. In the current task, the most likely position for this uvular was the preceding consonant. An interesting follow-up would be to compare identification rates for nonce words like [wask'erqa], where the mid vowel can be attributed to the following consonant and thus should be factored out in determining the place of the preceding consonant.

Conclusion: The results here show that allophonic vowel height differences are used as a strong cue to preceding consonantal place, but asymmetrically so. Vowels that are derived by an allophonic rule (here, the mid vowel [e]), and thus have a more limited distribution in the language as a whole, are used as a stronger cue than default vowels (here, the high vowel [i]).